SHELL CORRECTION EFFECTS IN QUASI-FISSION REACTIONS LEADING TO THE SYNTHESIS OF SUPERHEAVY ELEMENTS

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In reactions used for the synthesis of superheavy elements the shell effects are manifested in the mass distribution of quasi-fission products: an increased yield of closed-shell nuclei, such as ^{208}Pb,^{132}Sn, is observed [1].

Quasi-fission (QF) is a nuclear process, which is realized in collisions of two massive nuclei. QF is the disintegration of a double-nuclear system, which is formed at the capture stage and evolves into the symmetric form. Quasi- fission is the dominant channel in nuclear reactions used for the synthesis of superheavy elements. In reactions of synthesis of superheavy elements there are indications for the influence of the nuclear structure of the DNS nuclei on the probability of the system disintegration observed in the mass distribution of quasi-fission products - nuclear fragments with closed shells have the greatest yield.

In the framework of our model [2] quasi-fission is considered as the process of evolution of the double-nuclear system (DNS), formed at the capture stage, in the direction of decreasing its charge and mass asymmetry, accompanied by the decay of the system via all intermediate and final configurations. The evolution of the DNS is handled by the system potential energy - a function of its charge (mass) asymmetry and the interaction angular momentum. In the reactions of synthesis of superheavy elements the DNS energy is small. For this reason in calculations of the potential energy the real (table) masses of the interacting nuclei rather than the liquid drop values are used. In the potential energy curve quite deep minima occur for those DNS configurations for which one of the system nuclei is a doubly magic one. The DNS evolution is retarded in these minima, which in turn leads to an increased yield of the corresponding fragment-nuclei.

Our model offers a clear and realistic interpretation of the quasi-fission process and occurrence of shell effects in the mass distributions. The model based on this concept allows one to reproduce the shell effects in experimental mass distributions of quasi-fission products.

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References

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